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REMARKS

Claims 11, 14-16, and 18-29 are pending in the present application. In view of the following remarks, Applicant respectfully requests withdrawal of the present final rejection and allowance of pending claims 11, 14-16, and 18-29.

The Examiner has rejected claims 11, 14-16, 18, 20-23, and 2-28 under 35 USC §102(e) as being anticipated by U.S. patent number 6,014,318 to Shinji Takeda ("Takeda"). For the reasons discussed below, Applicant respectfully submits that the present invention, as defined by independent claims 11, 20, and 25, is patentably distinguishable over Takeda.

Initially, Applicant notes that the present invention is directed to effectively securing mold compound to a printed circuit board to prevent a semiconductor die mounted on the printed circuit board from delaminating and causing circuit failure. The present application discloses in detail how the invention secures mold compound to a printed circuit board by forming a hole, which can be a through and/or blind hole, in the printed circuit and completely filling the hole with mold compound during a molding process. As a result of a chemical and mechanical bond that is formed between the printed circuit board and the portion of mold compound that completely fills the hole, the portion of mold compound in the hole acts as a plug and locks the remaining portion of mold compound to the printed circuit board. Thus, by forming a hole in the printed circuit board and completely filling the hole with mold compound, the mold compound in

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the hole acts as a plug and essentially "stakes down" the remaining portion of mold compound to the surface of the printed circuit board and the semiconductor die.

The present invention, as defined by independent claims 20 and 25, recites, among other things, a first portion of mold compound surrounding and covering a die, a through hole traversing first and second layers of metal of a printed circuit board, where the through hole is completely filled with a second portion of mold compound, and where the second portion of mold compound in the through hole locks the first portion of mold compound into the printed circuit board. As disclosed in the present application, during a molding process, mold compound surrounds and covers the die attached to the top surface on the printed circuit board. During the molding process, the mold compound is forced into the through hole such that the through hole is completely filled with a portion of the mold compound.

As discussed above, the portion of mold compound that is situated in the through hole achieves a strong chemical and mechanical bond with the walls of the through hole, which effectively "stakes down" the portion of mold compound surrounding the die to the second layer of metal on the top surface of the printed circuit board. Thus, by completely filling the through hole with a portion of mold compound, the present invention significantly increases the mechanical and chemical adhesion between the mold compound and the printed circuit board and, therefore, substantially increases the reliability of the plastic laminate-based molded IC package.

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In contrast to the present invention as defined by independent claims 20 and 25, Takeda does not teach, disclose, or suggest a first portion of mold compound surrounding and covering a die, a through hole traversing first and second layers of metal of a printed circuit board, where the through hole is completely filled with a second portion of mold compound, and where the second portion of mold compound in the through hole locks the first portion of mold compound into the printed circuit board. Takeda teaches a BGA package that utilizes vapor holes to provide an exhaling route for water expanded by vapor-phase expansion caused by mounting heat inside the package. Takeda specifically discloses vapor holes 7, which are exposed vertically from the boundary face of sealing resin at wiring substrate 1 and which provide exhaling routes of expanded water vapor formed in wiring substrate 1. See, for example, column 6, lines 4-11 and Figure 9 of Takeda. However, Takeda fails to teach, disclose, or even remotely suggest completely filling vapor holes 7 with mold compound, as specified by independent claims 20 and 25. Indeed, vapor holes 7 cannot be completely filled with mold compound, since they must provide exhaling routes of expanded water vapor. As such, Takeda in fact teaches away from the present invention, since Takeda requires at least some open passage for water vapor to escape through vapor holes 7.

In Takeda, sealing resin 3, which is formed by transfer molding, covers the upper part and the sides of the wiring substrate on which the semiconductor chip is mounted. See, for example, column 6, lines 20-23 and Figure 6 of Takeda. However, Takeda does not teach, disclose, or suggest that sealing resin 3, which functions as a mold compound,

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completely fills or even partially fills vapor holes 7. In fact, as shown in Figure 6 of Takeda, sealing resin 3 is indicated without any shading or cross-hatching while vapor holes 7 are indicated with horizontal lines extending through them (i.e. the vapor holes).

In the present invention, the same mold compound that covers the semiconductor die also completely fills the through hole or the blind hole in the printed circuit board. In Takeda, even if as the Examiner suggests vapor holes 7 are partially filled, the filling material is not the same mold compound that covers the Takeda semiconductor die. In other words, Takeda is not directed to and does not teach the desirability of the same mold compound covering both the semiconductor die and filling the vapor holes. In fact, Takeda is not directed to preventing the delamination of a semiconductor die from a printed circuit board. Thus, there is no reason for Takeda to teach or suggest the utilization of the same mold compound to cover both the semiconductor die and to fill the through holes. Indeed, Takeda is not directed to the problem of delamination from a printed circuit board; instead, Takeda is directed to the problem of allowing vapor to pass through a substrate in a BGA. For example, planar portion 22 of Takeda is not at all analogous to metal plate 36 in the present application. As disclosed and claimed by the present invention, semiconductor die 16 is prone to being delaminated from metal plate 36 due to, at least in part, the natural difficulty in adhering to a metal surface (i.e. to the surface of metal plate 36). However, "planar portion 22" in Takeda is nowhere disclosed to be a metal and, further, there is no discussion in Takeda regarding lack of adhesion of Takeda's semiconductor chip 2 to its "planar portion 22."

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Thus, in Takeda, since vapor holes 7 are not completely filled with the same mold compound, vapor holes 7 do not and cannot lock a first portion of mold compound into the printed circuit board, as specified in independent claims 20 and 25. Therefore, for the reasons stated above, the vapor holes disclosed in Takeda, which provide an exhale route for expanding water vapor, are significantly different from the through holes specified in independent claims 20 and 25, which are completely filled with mold compound to act as a plug to lock down the mold compound to a printed circuit board.

The present invention, as defined by independent claim 11, recites, among other things, a blind hole extending through the second layer of metal of a printed circuit board, where the blind hole is completely filled with the same mold compound that covers the semiconductor die. The present invention, as defined by independent claim 11, achieves similar advantages as the present invention as defined by independent claims 20 and 25 discussed above. Additionally, with respect to independent claim 11, Takeda fails to teach, disclose, or remotely suggest a blind hole, which, as disclosed in the present application, extends only a certain depth into the printed circuit board. Moreover, vapor holes 7 cannot be blind holes, since vapor holes 7 must provide an exit route through which water vapor can escape.

For the foregoing reasons, Applicant respectfully submits that the present invention, as defined by independent claims 11, 20, and 25, is not suggested, disclosed, or taught by Takeda. As such, the present invention, as defined by independent claims 11, 20, and 25, is patentably distinguishable over Takeda. Thus claims 14-16 and 18-19

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depending from independent claim 11, claims 21-23 depending from independent claim 20, and claims 26-28 depending from independent claim 25 are, *a fortiori*, also patentably distinguishable over Takeda for at least the reasons presented above and also for additional limitations contained in each dependent claim.

The Examiner has further rejected claims 19, 24, and 29 under 35 USC §103(a) as being unpatentable over Takeda in view of U.S. patent number 5,825,628 to Garbelli et al ("Garbelli"). As discussed above, independent claim 11, 20, and 25 are patentably distinguishable over Takeda. Thus claim 19 depending from independent claim 11, claim 24 depending from independent claim 20, and claim 29 depending from independent claim 25 are, *a fortiori*, also patentably distinguishable over Takeda for at least the reasons presented above and also for additional limitations contained in each dependent claim.

Based on the foregoing reasons, the present invention, as defined by independent claims 11, 20, and 25 and claims depending therefrom, is patentably distinguishable over the art cited by the Examiner. Thus, claims 11, 14-16, and 18-29 pending in the present application are patentably distinguishable over the art cited by the Examiner. As such, and for all the foregoing reasons, the withdrawal of the present final rejection and an early Notice of Allowance for all claims 11, 14-16, and 18-29 pending in the present application are respectfully requested.

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Respectfully Submitted,
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